which we deem entirely superfluous. We fail to discern the purpose served by pictures of a "graduated cylinder," a "beaker," a "burette and rubber tubing," a "specimen jar," "small wooden tables," a "casserole," a "scalpel," a "hemostat," an "evaporating dish," or of clamps, forceps, screws, scissors, oxygen tanks, hand bellows, bottles for holding stock solutions, and similar common utensils with which every student and laboratory boy becomes familiar as soon as he enters the class-room. Such illustrations could be obtained at a much less expense, if need be, from any laboratory supply dealer, by writing for an illustrated catalogue.

Barring the unnecessary mass of subordinate detail in the text and illustrations, Jackson's treatise has certain admirable features. The style of the author bespeaks his intense earnestness of purpose and interest in the subject. The descriptions of his original or improved methods are often admirable and illuminating. A number of experiments are described which are not found in the ordinary text-book. Among these may be mentioned especially experiments on the eyes, intratracheal insufflation, elaborate and newer methods of anesthesia, oncometric and other experiments on the spleen and other organs, methods for the study of esophageal, vesical and uterine contractions, and the author's *chef d'oeuvre*—his ingenious methods of studying pulmonary conditions, namely, pulmonary circulation, pulmonary pressure, and the contractions of bronchioles. Altogether, Jackson's "Pharmacology" is a unique and interesting work and will be found helpful by the pharmacologist, especially in the execution of some particular kind of work.

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APHIS IMMUNITY OF TEOSINTE-CORN HYBRIDS

Certain properties and functions are possessed by some plants and animals providing them exemption from disease. The use of the word disease as applied to plants is sometimes restricted to bacterial and fungous parasitism and its effects. It is also sometimes applied to disorders brought about by various forms of malnutrition, including attacks by insects and other low forms of animal life.

When the favorable conditions of life are so seriously interfered with by any agency, so that the life of a part of a plant or of the whole plant is threatened, we recognize disease in that plant.

When a plant is able to repel such devastating forces, more or less completely, it is said to possess corresponding degrees of total immunity.

Plants and animals are also subject to depredatory attacks of small animal life, parasitic in nature, but not producing what is ordinarily conceded as organic disease. Certain individuals repel or resist such depredations and it seems proper to call this phenomenon immunity.

It is with a behavior belonging to the last-named category that this account is concerned. The appearance of an instance of total immunity of any kind in an economic plant or animal seems eligible to record, and especially when the immunizing factor is hereditary.

During the early summer of 1913 there were grown in a greenhouse four short rows of F_1 or first generation hybrid plants coming from seed produced by fecundating teosinte, *Euclanea mexicana* with pollen of yellow dent corn, *Zea indentata*.[1] In the same bed, and immediately adjoining the hybrid rows, were grown one row of the parent strain of teosinte on the one side and four rows of the parent strain of corn on the other.

[1] Teosinte and corn are both members of the grass family, but are classed in different genera. They hybridize freely with each other, although the teosinte is decidedly grasslike in appearance producing small two-rowed fruiting spikes in marked contrast to ears of dent corn. The first hybrid generation is intermediate in structure between the two parents, but more nearly resembling the teosinte in tillering profusely and being tall, slender and foliaceous. The hybrid ears are also small, fitting rigidly into a cavity of an internode of the rachis which disjoints readily at maturity, but succeeding generations produce some larger fruiting spikes more like the dent-corn parent.

As the spring season advanced several species of ants began visiting this bed. Later, colonies of aphis were found upon the roots of the corn, and finally heavy infestations upon the upper parts of a number of the corn plants. During four months of almost daily scrutiny no aphis was ever discovered upon either the teosinte or the hybrids. Ants were noticed occasionally upon these plants but their visits were apparently fruitless. A dozen or more hills of teosinte had been grown in 1909 and again in 1910 in cornfields heavily infested with aphis, but none had been noticed on the teosinte, although no particular attention was given to this question at the time.

The colonies of aphis in the greenhouse were sprayed effectively at intervals, but new colonies again appeared on the corn. It is well known that corn plant aphis, when not in the winged state of metamorphosis, frequently depend upon ants for transportation over short distances, *e. g.*, from one plant to a neighboring plant, as well as from one region to another on the same plant. The ants act as herders and protectors of the aphis, taking their toll in the sweet sticky fluid secreted by the aphis. The aphis are moved to a new feeding spot or pasture when the supply of fluid is not satisfactory to their herders.

The occasional appearance of ants searching over the teosinte and hybrid plants, indicated that the ants undoubtedly were willing and perhaps did perform their share of the compact, and that the aphis were unable to subsist upon the tissue of these host plants. Aphis in the winged stage, probably, lodged many times upon the immune plants.

It was learned that there were two recognizd forms of aphis involved in the problem, namely, the corn root-aphis, *Aphis maidiradicis*, and the corn plant-aphis, *Aphis maidis;* one working only or almost entirely on the roots and the other on the culm of the corn plant. The former is more numerous and destructive in corn fields.

The attacks of the sap-sucking aphids do not produce disease other than depleted plant tissue and local lesion in the area upon which they are at work. A portion of the insect secretions is waste—popularly known as "honeydew"—and produces the characteristic sticky, gummed and soiled surface where the aphis and the ants have been operating.

Just as there is no important grape-growing region free from the devastating woolly aphis or phylloxera of the vine; so, also, there is probably no corn-growing region of importance, in North America at least, which is free from the root-aphis of corn. There is no way of estimating accurately the enormous loss in reduction of yield caused by these insects which are steadily increasing in numbers and extent of migration, but this loss is known to be very great indeed. In Central Illinois the damage by the corn root-aphis sometimes causes total failure of the crop in limited areas.

Careful cultural methods may reduce considerably, for the time being, the number of aphis in a cornfield; yet the field may become reinfested from surrounding, untreated fields of corn and from other plants upon which the aphis are known to subsist.

Forbes reports finding from eleven to twenty-two generations of corn root-lice in one season. He estimates three hundred and nineteen billion lice and three trillion eggs left in the ground at the end of the season for each louse hatched in the spring. These figures are based upon the average rate of production with no undue break in the cycle.

> It is this high rate of multiplication by a number of successive generations which makes the root lice so destructive, even in fields first entered by a few winged lice borne on the wind from some neighboring field which has become more or less overstocked.

We may conclude that improved cultural methods and other common treatment will, at best, protect the cornfield only for a short interval. A more effectual remedy and permanent solution of the problem is to be welcomed. The amount of work connected with a thorough investigation of this discovery would have been far greater than the writer was able to undertake personally in connection with his other duties.

Perhaps in no one instance of reported resistance to disease and insect attack has the nature of the immunity been fully ascertained or circumscribed, although it is generally conceded as being highly desirable to determine the particular immunizing properties. In some cases it is thought to be due to hardiness of the individual, or vigor of growth; in others, to the durability, composition, or peculiarity of structure of the affected tissue.

In the plantlet stage of growth there is not much difference between the corn and the teosinte except that the leaves and stem of the latter are narrower and more slender. As the plants grow older the leaves of the teosinte are tougher and more leathery in texture, with pronounced teeth along the edges of the leaf. The corn leaves become slashed and torn to ribbons by wind storms, while the long narrow, and tough leaves of the teosinte remain entire. The sap of the corn plant is sweeter than the sap of the teosinte.

In the above-mentioned features the F_1 resembles the teosinte more than it does the corn. Since the aphis are sap suckers, the sweeter juice and more readily penetrated epidermis of the corn plant may be the deciding factors of immunity for the teosinte and the hybrid. This remarkable immunity apparently provided material upon insect parasitism as a means of determining genetic relationship and elucidation of the problem of inheritance of immunizing properties in plants.

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SPECIAL ARTICLES

THE TILLERING OF WHEAT

During the past eight years the writer has made a rather extended study of the tillering of winter wheat. The factors studied may be divided into two general classes, viz., heredity and environment. It has been found that the tendency to tiller appears to be largely a varietal characteristic. In order to study the behavior of the wheat plant with respect to tillering it was found necessary to plant the kernels in hills 6 by 6 in. apart. Two kernels were planted and later the plants thinned to one per hill. This method of seeding allowed the plant sufficient space to express rather fully its tendency to tiller. Seedings were also made by drilling in rows as is usually done in practical wheat culture. In this case, however, the number of tillers per plant could not be so accurately determined at harvest owing to the crowded condition of the plants in the row. As the plants came up the number was determined for a definite length of drill row. At harvest the total number of culms within this space was noted and divided by the number of plants. This gave the average number of tillers per plant. Where the wheat was seeded in hills each plant was cut separately and the culms counted. The mean for each variety was then determined by dividing the total number of culms by the number of plants. More than 150 varieties and strains of winter wheat were included in these tests. It was noted that the bearded wheats as a class seem to tiller more freely than the smooth. In order to test this characteristic of varieties more thoroughly identical varieties were grown the same season on both fertilized and untreated soil. All of the experiments were conducted in the field. The following table gives the average number of tillers per plant for four varieties of wheat, two smooth and two bearded.

TABLE I

Number of Tillers per Plant of Four Varieties Grown under Different Conditions

Test No.	Smooth		Bearded	
	Red Wave	Invincible	Red Wonder	Mediterranean
1	5.13	4.74	6.19	7.95
2	5.05	4.13	6.73	6.72
3	5.45	6.24	8.81	8.90
4	3.39	4.04	5.58	6.68
5	7.10	6.28	8.58	9.39
6	2.94	2.78	4.02	4.44
7	4.08	4.81	6.33	7.16
8	2.20	2.73	3.15	4.63
9	1.09	1.22	1.77	1.92
10	1.02	.98	1.29	1.45
11	.98	.97	1.06	1.20
12	1.14	2.04	2.95	2.63
13	1.01	1.07	1.81	1.69
14	1.01	1.19	1.46	1.39